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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/828,441	04/20/2004	Li-Qun Xia	AMAT/6392.C1/DSM/LOW K/JW	4006
44257	7590	05/05/2006		EXAMINER
PATTERSON & SHERIDAN, LLP 3040 POST OAK BOULEVARD, SUITE 1500 HOUSTON, TX 77056			NGUYEN, HA T	
			ART UNIT	PAPER NUMBER
			2812	

DATE MAILED: 05/05/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	Application No.	Applicant(s)
	10/828,441	XIA ET AL.
	Examiner Ha T. Nguyen	Art Unit 2812

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) Responsive to communication(s) filed on 13 February 2006.
- 2a) This action is **FINAL**.                            2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) Claim(s) 26-28,30,35-37,39 and 46-61 is/are pending in the application.
  - 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) Claim(s) 46-50 is/are allowed.
- 6) Claim(s) 26-28,30,35-37,39,51-61 <sup>41</sup> is/are rejected.
- 7) Claim(s) \_\_\_\_\_ is/are objected to.
- 8) Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

HANGUYEN  
PRIMARY EXAMINE

**Application Papers**

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on \_\_\_\_\_ is/are: a) accepted or b) objected to by the Examiner.
 

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
  - a) All    b) Some \* c) None of:
    1. Certified copies of the priority documents have been received.
    2. Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
    3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) Notice of References Cited (PTO-892)
- 2) Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_.
- 4) Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) Notice of Informal Patent Application (PTO-152)
- 6) Other: \_\_\_\_\_.

## DETAILED ACTION

### *Notice to applicant*

1. Applicants' Amendment and Response to the Office Action mailed 11-08-2005 has been entered and made of record .

### *Claim Rejections - 35 USC 103*

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103 and potential 35 U.S.C. 102(f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 26-28, 30, 35-37, 39, 41, and 57-61 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chooi et al. (USPN 6436824, hereinafter "Chooi") in view of Xia et al. (EP 1050601, hereinafter "Xia").

Referring to Figs. 1-3 and related text, Chooi discloses

[Re claim 26] a method for depositing a silicon carbide layer on a substrate, comprising: introducing a processing gas comprising an organosilicon compound and a dopant compound into a processing chamber containing the substrate therein (see embodiments 1-3], wherein the organosilicon compound consists essentially of silicon, carbon, and hydrogen, and has a carbon

atom to silicon atom ratio of 6:1 or greater (see col. 3, lines 33-60); and reacting the organosilicon compound to form the silicon carbide layer having a dielectric constant in the range of 3-6.5 (see col. 3, lines 33-col. 4, line 29). But it does not disclose expressly wherein the dopant compound is selected from the group consisting of a boron-containing compound, a phosphorus-containing compound, and combinations thereof. However the missing limitation is well-known in the art because Xia discloses this feature (see par. 72).

[Re claims 35-37] Chooi also discloses a method for processing a substrate having metal 14 therein, comprising: depositing a barrier layer 16 on the substrate on the metal features by introducing a processing gas comprising an organosilicon compound into a processing chamber containing the substrate therein, wherein the organosilicon compound consists essentially of silicon, carbon, and hydrogen, and has a carbon atom to silicon atom ratio of about 6:1 or greater and the barrier layer has a dielectric constant in the range of 3-6.5; and the dopant compound, and depositing a first dielectric layer adjacent the barrier layer, wherein the first dielectric layer 18 comprises silicon, oxygen, and carbon and has a dielectric constant of about 3 or less, as shown above; depositing a silicon carbide etch stop 20 on the first dielectric layer (see col. 3, line 45-col. 5, line 10). But it does not disclose expressly wherein the dopant compound is selected from the group consisting of a boron-containing compound, a phosphorus-containing compound, and combinations thereof and the generating a plasma of the processing gas and the claimed ranges.

[Re claims 57 and 59] Chooi discloses a method for depositing a silicon carbide layer on a substrate, comprising: introducing a processing gas comprising an organosilicon compound and a dopant into a processing chamber containing the substrate therein; and reacting the organosilicon compound to deposit the silicon carbide layer on the substrate wherein the organosilicon compound has the formula  $\text{SiHa(CH}_3\text{)}\text{b(C}_6\text{H}_5\text{)}\text{c}$ , wherein c is 1 and  $a+b+c=4$ ; wherein the organosilicon compound comprises dimethylphenylsilane (see col. 3, lines 9-col. 4, line 10, especially col. 3, line 53). But it does not disclose expressly wherein the dopant compound is selected from the group consisting of a boron-containing compound, a phosphorus-containing compound, and combinations thereof.

However the missing limitations are well-known in the art because Xia discloses the claimed dopant (see par. 72). Besides, in a PECVD process, the process gas enter into a reaction

in an energized ionized state, a plasma, it is inherent that the step of generating the plasma exists, and in the case where the claimed ranges “overlap or lie inside ranges disclosed by the prior art” a *prima facie* case of obviousness exists (See MPEP 2144.05).

At the time of the invention, an ordinary artisan is motivated to combine Chooi with Xia to reduce metal contamination (see par. 72).

[Re claims 27, 41 and 58] Chooi discloses substantially the limitations of claims 27, 41 and 58, as shown above. But it fails to disclose expressly the claimed dopant compound. However, Xia discloses this feature (see par. 72).

[Re claims 28 and 39] Xia also discloses exposing the silicon carbide layer to a plasma treatment process (see par. 79).

[Re claim 30] The combined teaching of Chooi and Xia does not teach wherein the ratio of dopant compound to organosilicon compound comprises between about 1:5 and about 1:100. However any variation in reactants ratio in the present claim is obvious in light of the cited art, because the changes in reactants ratio produce no unexpected function. *The routine varying of parameters to produce expected changes are within the ability of one of ordinary skill in the art. Patentability over the prior art will only occur if the parameter variation produces an unexpected result. In re Aller, Lacey and Hall, 105 U.S.P.Q. 233, 235. In re Reese 129 U.S.P.Q. 402, 406.*

[Re claim 60] Chooi also discloses wherein the silicon carbide layer is deposited in a damascene structure as a material layer selected from the group consisting of a silicon carbide-containing barrier layer and a silicon carbide-containing etch top layer (see col. 3, lines 9-col. 4, line 10). But it does not disclose expressly all the features in the same process. However, it would have been obvious to an ordinary artisan to modify Chooi’ s teaching to obtain devices meeting the requirements of a specific applications;

[Re claim 61] wherein the silicon carbide layer has a dielectric constant of between about 3 to 6.5. But it does not disclose expressly a value of less than 4. However, in the case where the claimed ranges “overlap or lie inside ranges disclosed by the prior art” a *prima facie* case of obviousness exists. *In re Wertheim, 541 F. 2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F. 2d 1575, 16 USPQ 2d 1934 (Fed. Cir. 1990).*

Therefore, it would have been obvious to combine Chooi with Xia to obtain the invention as specified in claims 26-28, 30, 35-37, 39, 41, and 57-61.

4. Claims 26-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Laxman et al. (USPAPN 2002/0172766, hereinafter "Laxman") in view of Xia et al. (EP 1050601, hereinafter "Xia").

[Re claims 26-27] Laxman discloses a method for depositing a silicon carbide layer on a substrate, comprising: introducing a processing gas comprising an organosilicon compound and a dopant compound into a processing chamber containing the substrate therein, wherein the organosilicon compound consists essentially of silicon, carbon, and hydrogen, and has a carbon atom to silicon atom ratio of 6:1 or greater (see par. 67 and 87); and reacting the organosilicon compound to form the silicon carbide layer having a dielectric constant less than 3 (see pars. 76-84, 87, and 89). But it does not disclose expressly the claimed dopant, all the limitations in the same process and the claimed ranges. However, Xia discloses the claimed dopant, as shown above, it would have been obvious to an ordinary artisan to use the disclosed features in the same process to obtain device meeting the requirements of a specific application. Besides, in the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a *prima facie* case of obviousness exists (See MPEP 2144.05).

[Re claim 28] Laxman discloses exposing the silicon carbide layer to a plasma treatment process (see par. 101).

5. Claims 51-56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chooi in view of Xia and Yang et al. (USPN 6365527, hereinafter "Yang").

[Re claim 51] the combined teaching of Chooi and Xia discloses a method for depositing a silicon carbide layer on a substrate, comprising: introducing a processing gas comprising an oxygen-containing compound, a dopant, and an organosilicon compound that consists essentially of silicon, carbon, and hydrogen, and has a carbon atom to silicon ratio of 6:1 or greater to carbide layer on the substrate; reacting the organosilicon compound by a PECVD process to deposit the silicon carbide layer on the substrate, [Re claim 52] exposing the silicon carbide layer to a plasma treatment process; [Re claim 53] wherein the dopant is selected from the group

consisting of phosphine (PH<sub>3</sub>), borane (BH<sub>3</sub>), diborane (B<sub>2</sub>H<sub>6</sub>), and combinations thereof, as shown above. But it fails to disclose wherein the silicon carbide layer comprises less than about 15 atomic percent of oxygen and exposing the deposited silicon carbide layer to a plasma treatment process. However, the missing limitations are well known in the art because Yang discloses these features (col. 3, lines 34-45). At the time of the invention, an ordinary artisan is motivated to combine Chooi and Xia with Yang to reduce oxygen content in the silicon carbide for use in oxygen-sensitive process.

[Re claim 54] Chooi discloses that wherein the silicon carbide layer has a dielectric constant of less than 4 (see col. 4, lines 1-29);

[Re claim 55] wherein the silicon carbide layer is deposited in a damascene structure as a material layer selected from the group consisting of a silicon carbide-containing barrier layer and a silicon carbide-containing etch stop layer (see Fig. 2); and

[Re claim 56] depositing a dielectric layer 22 adjacent the silicon carbide layer.

Therefore, it would have been obvious to combine Chooi and Xia with Yang to obtain the invention as specified in claims 51-56.

#### *Allowable Subject Matter*

6. Claims 46-50 are allowed.

Claim 46 recites wherein the organosilicon compound has the formula SiHa(CH<sub>3</sub>)<sub>b</sub>(C<sub>6</sub>H<sub>5</sub>)<sub>c</sub>, wherein c is 2 and a+b+c = 4.

This features in combination with the other elements of the claim is neither disclosed nor suggested by the prior art of record.

Claims 47-50 variously depend from claim 46, they are allowed for the same reason.

#### *Response to Amendment*

7. In view of applicants' arguments and amendments to the claims, the rejections of claims 26-28, 30, 35-37, 39, and 41, as stated in the immediately preceding Office Action have been withdrawn. Applicants are referred to the modified or new grounds of rejection, given above.

Applicant's arguments with regard to the rejections under 35 U.S.C. 103 have been fully considered, but they are not deemed to be persuasive for at least the following reasons.

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Applicants argued that Chooi is silent as to organosiloxane compounds. This is deemed irrelevant since organosiloxane compounds are not claimed.

Applicants argued that Chooi cannot be combined with Xia because Chooi discloses a PECVD while Xia discloses a thermal CVD, the examiner disagreed. Xia does not only use thermal CVD in a PECVD chamber but Xia also disclose the use of a combination of a thermal and a PECVD (see par. 75). Besides, both processes are CVD processes involving reactions between gaseous reactants. Therefore, they are combinable. In the combined teaching of Chooi and Xia, the gaseous reactants including organosilicon compound (s) and dopant compound are introduced in the process chamber.

Applicant also argued that Xia discloses a SiOC not a silicon carbide. The examiner disagreed, in a broader interpretation SiOC is a silicon carbide since no specific composition of the material is claimed. *The examiner is to give claims their broadest reasonable interpretation in light of the supporting disclosure See, e.g., In Re Aletz, 893 F.2d 319, 321-22, 13 USPQ2d 1320, 1322 (Fed. Cir. 1989) (see MPEP 2111).*

Note that applicant's arguments are largely directed to what the cited references teach individually. However, it is axiomatic that one cannot show nonobviousness by attacking references individually where the rejection, as here, is based on a combination of references. *In re Young, 403 F.2d 754, 159 USPQ 725 (CCPA 1968); In re Keller, 642 F.2d 413,208 USPQ 871 (CCPA 1981).* For example, applicant argues that Yang does not disclose the details about the processing gas as here claimed. However, Chooi or Xia, not Yang, is employed in the rejection to show each of the feature of the claimed process.

Therefore, the applied reference do teach or make obvious all the features of the rejected claims .

### ***Conclusion***

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP. 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for response to this final action is set to expire THREE MONTHS from the date of this action. In the event a first response is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after

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the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event will the statutory period for response expire later than SIX MONTHS from the date of this final action.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ha T. Nguyen whose telephone number is (571) 272-1678. The examiner can normally be reached on Monday-Friday from 8:30AM to 6:00PM, except the first Friday of each bi-week. The telephone number for Wednesday is (703) 560-0528.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael S. Lebentritt, can be reached on (571) 272-1873. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

HN

04- 28- 06



Ha Tran Nguyen  
Primary Examiner